

Is Videoconferencing the Killer App¹ for K-12 Distance Education?

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Abstract

This paper overviews a multi-mode research study of Internet Protocol (IP) videoconferencing applications in five early adopter school divisions in Alberta, an oil-rich province located in Western Canada. The applications exploited the affordances of the Alberta SuperNet, a new, very high speed digital network. The study included site visits, surveys, structured classroom observations, and research interventions. The study revealed effective use of videoconferencing for enrichment, professional development, and administration, with less successful application as the primary tool for distance education delivery. I conclude the paper with a discussion of my own reflections on the use of videoconferencing and its capacity to serve as a 'killer app' for distance education.

Résumé

Cet article fait un survol d'une recherche multimodale d'applications de vidéoconférence par protocole IP dans cinq districts scolaire avant-gardistes en Alberta, une riche province productrice de pétrole dans l'Ouest canadien. Les applications exploitent les capacités du Alberta SuperNet, un nouveau réseau numérique à très haute vitesse. L'étude impliquait des visites sur les sites, des sondages, des observations structurées en classe, et des interventions de recherche. L'étude révèle une utilisation effective de la vidéoconférence pour l'enrichissement, le développement professionnel et l'administration, et un succès moins grand lorsqu'utilisé comme outil principal dans la diffusion de l'éducation à distance. En conclusion, je présente une discussion de mes réflexions sur l'utilisation de la vidéoconférence et sa capacité à servir de « killer app » pour l'éducation à distance.

Introduction

The promise of high speed digital networks to radically improve the operation of K12 schools has been proselytized by many but demonstrated or proven (to date) by fewer. For example, the Canadian

¹ The application that actually makes a sustaining market for a promising but under-utilized technology—Jargon File 4.4.7: <http://www.catb.org/jargon/html/K/killer-app.html>

National Broadband Task Force report enthusiastically claims that “broadband will transform the way we learn, the way we work, the way we use our leisure, the way we govern ourselves, the way we communicate, the way we express ourselves and the way we care for each other” (Johnson, 2001, p. 3).

In an effort to stimulate development and take advantage of emerging distributed and networked business and social opportunities, the Alberta government announced (2001) and completed (2005) the Alberta SuperNet. This very high-speed network connects every school, public health facility, and municipal government office in the province and brings 'urban priced' broadband networking to nearly every (457) city, town, and village in the province. At a public cost of \$193 (Canadian) million the SuperNet is a large scale, demand-side stimulation of the Alberta social, technical, and service landscape.

Consistently noted in the promotional materials that accompanied the SuperNet was an implication that public education (at all levels) would be a prime user and beneficiary of this intervention. Trattner, Wang and Carter (2000) argue that “information technology in education is an incredible resource and will, without question, continue to be the single most important component of 21st century education” (p. 34).

In an early presentation (Anderson, 2004) to educators, I probed the audience for their perception of the greatest benefits, applications, and barriers to effective use of this new network. The highest rated application was Internet Protocol (IP) videoconferencing. It seemed that educators realized that low-speed networks limited their capacity for high quality video transmission - thus when the capacity of the network was significantly increased, many educators believed that videoconferencing would be an ideal educational tool.

In conjunction with the large supply side investment in the network, smaller demand side stimulations were developed by Alberta Education to stimulate, support, and evaluate applications and technologies that would assist local schools in effectively using the SuperNet (Anderson & Christiansen, 2006). One of these interventions was the funding for the establishment of a “research community of practice” focused on the adoption and usage of videoconferencing by five 'early adopter' school districts located across the province. This research contract was awarded to a team of academics and professional media staff from Athabasca University, the University of Lethbridge and the Galileo Educational Network and was led by the author of this article. This report briefly summarizes the results of that project. The formal project report provides considerably more detail and is available with four descriptive videos at: <http://www.vcalberta.ca/documents/index.cfm>.

Research Questions

The study used an emergent research design broadly focused on answers to the following questions:

- How is IP videoconferencing (VC) being used by early adopter school divisions?
- What type of infrastructure and support is being provided to participants?

A final question, which was not part of the formal study, but one in which I have personal and professional interest, was answered by my observations and participation in this funded research project. This question is: Is videoconferencing the “killer app” as many feel or claim? In other words, does it provide radically new affordances that significantly improve K-12 schools?

Educational Videoconferencing Literature Review

VC has been used in educational settings for over 20 years. As a component of this project, we compiled a literature review focusing on K-12 applications of videoconferencing. This review is available on the VC Alberta web site at <http://www.vcalberta.ca/community/litreview.pdf>. Generally, the literature documents that videoconference use is associated with increased access, equal or better educational outcomes, and increases in positive attitudes towards technology use by participants. As an example of this literature Cavanaugh (2001) conducted a meta-analysis of K-12 distance education studies published between 1980 and 1998. Focusing on instructional activities and interactions between the attributes of learners and technologies, she identified differential outcomes for two distinct approaches to VC enhanced education. Programs that used interactive technologies, such as videoconferencing, to enhance traditional instruction yielded greater effects on achievement than programs that used interactive technologies as the primary tool to deliver instruction. Cavanaugh concluded that interactive media are most effective when used in moderation to achieve specific goals in combination with other methods and activities. A more recent example of the former use, is the linking of classrooms to museums for enhanced classroom interaction leading to the development of communities, enhanced student achievement, and development of new pedagogical designs (Newman, Barbanell, & Falco, 2005).

Much of the earlier educational VC literature derives from use of ISDN-based equipment which was much more expensive to purchase and operate than the technologies studied in this report. Videoconferencing today has considerable relative cost advantage over earlier generations of

this technology and is thus more accessible. In addition, this technology is personal computer and Internet-based, and thus more flexible and capable of multi-functioning in a wide variety of Net-based activities as compared to earlier technology. Finally, the technology is more sophisticated and feature rich, and although much of the technology is not yet 'user friendly,' it is much easier to use than earlier technology.

Videoconferencing is an educational technology that overcomes many of the objections that people have to education that occurs anywhere beyond the face-to-face classroom. It overcomes the lack of interaction associated with correspondence study, it provides a richer repertoire of communication modes unlike computer-conferencing and audio conferencing, and it allows teachers and students to engage in the types of classroom teaching and learning activities to which they are accustomed. Thus, it often serves as a familiar and compatible first experience of distributed education.

The visual images and body language transmission afforded by VC has been associated by some researchers (Short, Williams, & Christie, 1976; Biocca, Harms, & Burgoon, 2003) with higher levels of social presence. However, the term "social presence" has also been linked to text based asynchronous learning environments (Rourke, Anderson, Archer, & Garrison, 1999). Rather than debate the many dimensions and definitions of "social presence" it is safe to conclude that many communications researchers connect social presence with a feeling of "being there" or "co-presence". In this line of inquiry, unmediated, face-to-face communication is the 'gold standard' against which all other forms of mediated communication are matched. Videoconferencing and especially newer forms of 3D and high definition videoconferencing used in specially designed VC rooms have been shown to rate highly in terms of warmth, empathy attention allocation and other affective perceptions of communication quality (Hauber, Regenbrecht, Hills, Cockburn, & Billingham, 2005)

Though videoconferencing is like classroom teaching in many ways, it is not identical. Technology mediates the experience and causes various challenges related to decreased teacher presence, inability to interact within the learning context in quite the same way, increasing time and effort to exchange documents in the class, and reducing out of class contact between and among students and teachers. These disadvantages, of course, are balanced with the advantages of spanning geographic distance that is the prime benefit of all forms of distance education.

Technically, VC consumes large amounts of bandwidth providing an appropriate test application for staff interested in pushing the technological boundaries and exploiting the affordance of any new high speed network. Administratively, VC appeals to both technical early

adopters, wanting to visibly demonstrate their school's use of new technology, and to 'person orientated administrators', who are comfortable using their body language to inspire, lead, and administrate in settings compatible to the familiar face-to-face like meetings.

Perhaps most importantly for Alberta schools was the announcement by Alberta Education, midway through this research project, that each of the 62 public school districts in the province would receive a special, one-time funding of \$60,000 to purchase videoconference equipment and training. This subsidy was in addition to an ongoing commitment to pay the fees associated with the 5Mbps entry level bandwidth on the SuperNet. School districts were also granted permission to purchase higher levels of bandwidth at quite reasonable cost as their usage increases. Thus, the stage was set for significant and cost effective use of VC technology in Alberta Schools.

Method: Participative Design

The multi-institutional team of researchers chose a multiple case study methodology to analyze the five early adopter school jurisdictions. Our task was to document, query, and support the applications of videoconferencing technology on the SuperNet. Our role as research participants also allowed us to participate and co-facilitate (with Alberta Education staff) the development of a research community of practice with teaching, technical, and administrative staff from the five school jurisdictions. In a review on school research networks, Frost, Cullen and Cunningham (2004) comment that "Engagement in researching school networks is perhaps made especially intellectually stimulating by the considerable diversity of ideas in play, including some of a very ambitiously transformative nature" (p. 80). They also note the participation of external agencies (often a university) in school networks to be associated with strong performance of the research network.

Participation in the research community of practice occurred during three face-to-face meetings, online at a custom designed 'community of practice portal' (VCAAlberta.ca), through scheduled professional development activities, and through conversations online via telephone and face-to-face during site visits.

To provide answers to our research questions and other emerging issues, we engaged in a series of participatory and research focused activities that included:

- initial review of the research literature on K-12 Internet-based VC (For a complete literature review, visit vcalberta.ca/community/litreview.pdf);

- site visits to introduce and familiarize ourselves with the context in the five cases;
- development of survey instruments and interview questions;
- second site visits to videotape classes and interview participants
- participation in face-to-face research community colloquiums with participants from all five divisions to share insights and build consensus on major issues to be investigated;
- development of a web portal containing a provincial directory of VC facilities, resources for effective practice using VC, and community participation tools (<http://vcalberta.ca>);
- a third site visit to present and confirm initial findings;
- observations and interviews with teachers, administrators and students;
- production of four videographies documenting the use of VC in the cases (available at vcalberta.ca);
- mentoring teacher volunteers on use of inquiry based education designs supplemented by VC;
- facilitation of three after school PD events delivered via distributed technologies (VC and web conferencing).

Space limitations preclude extensive presentation and discussion of all components of this study, however highlight those I feel are of particular salience below.

Technology in Use

There was quite a wide variety of technology, furniture, and room design employed in the five districts. All systems used “room” sized IP VC equipment with four of the five using industry standard H323 protocol equipment. There was considerable debate about the most appropriate number and size of display monitors. Some schools used projection monitors, while others preferred multiple LCD or CRT video monitors. Screen size and mode of switching video projection among sites (voice or teacher activated) also varied, but the challenges were compounded when multiple sites were involved. Generally, teachers preferred projections that continuously showed all sites (in smaller formats) than extensive switching to highlight particular activity at any one site. Although multiple sites displayed on a single screen did give a sense of continuous supervision, we were disappointed at the resolution and clarity of the remote images when screens were projecting multiple sites. Room configuration also varied from custom built delivery suites (dedicated desks, multiple microphones, appropriate paint and lighting, efforts at sound proofing, etc.) to mobile units in which the VC equipment was wheeled into ordinary classrooms. As expected, satisfaction of

participants seemed to improve with increased expenditures on VC rooms, however, we also heard from teachers of their desire to move about while teaching, and not be confined to delivery from a fixed and often inflexible workstation or podium.

Most rooms were also equipped with a variety of peripherals including documents, cameras, fax/printers, monitors for teachers to view their own projection, and touch screens. In one system, small desktop VC units were also provided for individual work but these were seldom used. Rarely did we observe networked computers located in rooms specifically designed for student use of VC.

Video Conference Applications

Our first trip to the five school districts revealed, as expected, that the videoconferencing was used in quite different ways and its application had evolved in response to different needs, contexts, technical capacity, experience, and personnel. Generally three broad applications of the technology emerged. First, videoconferencing was used in rural districts as a direct delivery tool for distance education courses. Second, all districts were using VC as an administrative tool for a variety of meetings and professional development activities. Third, the technology was used to afford enrichment activities with classroom students interacting, at a distance, with selected peers, experts, and celebrities.

Distance Delivery

Distance education applications were seen as a critical component for rural school divisions struggling to provide full curriculum access to students in small high schools. In one case classes were delivered almost exclusively from a large urban high school to one or more remote schools, while in other cases administrators were careful to include both delivery and reception of courses from all participating schools. The instructional design of the courses was generally not developed beyond simple technical substitution of activities from a classroom to distributed mode. For example, fax machines were used to 'handout' worksheets and display cameras were used for demonstrations and sharing of artifacts. Teachers were typically given minimal technical or pedagogical training and support, but most were attracted to the pioneering opportunity and implied professional development involved in participation in the VC courses. Technically, the systems functioned reliably (or at least reliably enough for ongoing and regularly scheduled classes) and were observed to be marginally functional for most classroom activities. By marginally, I mean that most learning activities worked, but sometimes participants had to move to microphones, the colouring of distributed lab experiments was slightly off, or other inconveniences arose that required teacher and

student ingenuity and time to resolve. Technical complications arose when multi-point distributions (multiple background noise, increase turn taking contention, competition for available screens, etc.) were used. Quality audio connections in which each participant could clearly talk and hear all other students at the same time was problematic in all distance education applications observed, but students and teachers learned techniques and acquired technologies (notably wireless teacher microphones) to overcome most challenges observed.

A wide variety of classes were distributed via the VC network. The most popular were upper-level, high-school classes to which both shortages of qualified teachers and smaller demand made the distributed capacity of this delivery method most attractive. We also observed second language, religious study and even elementary school programming delivered in the five schools districts.

We did a small sample (three classes, different subjects and teachers) of time observation and activity classification using Flanders' Classroom Interaction Analysis Protocol. We observed that the vast majority of class time in the three distance education classes was consumed by 'teacher talk' with the primary activity being lecturing. Secondary activities included lab work, asking questions, and responding to student ideas. An example of data from a single science class that we videotaped is presented in Figures 1 and 2. There were large variations, as appropriate

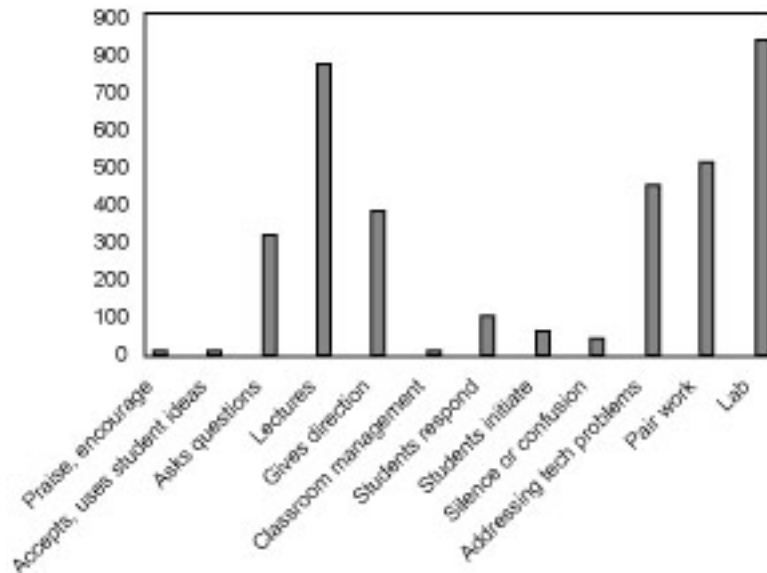


Figure 1. Time allocation in seconds in science class by activities

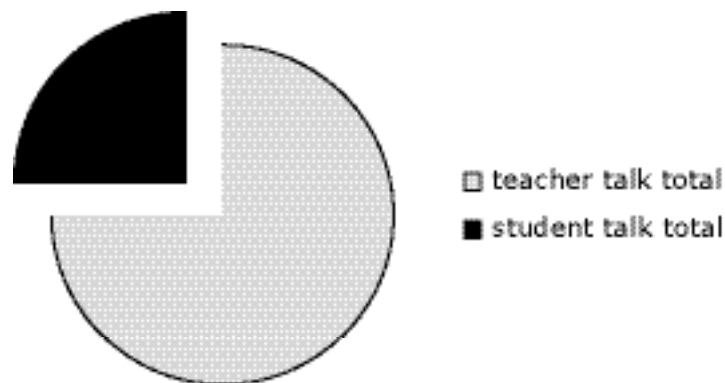


Figure 2. Categories of talk by time in seconds in a high school science class

considering the different contexts and disciplines being taught; nonetheless, high levels of 'teacher talk' to 'student talk' dominated our data collection and observations.

Participants in distance education courses tended to frame each of the issues in comparison to their conventional classroom or to correspondence study. The axis on which these comparisons revolved was interaction based on the technology's capacity to support one-on-one interaction with the teacher, class discussion, and student-to-student interaction. In the words of one student, "VC was better than correspondence, but not quite as good as face-to-face."

We conducted informal researcher designed surveys ($n = 96$) with a convenience sample of students in distance education classes we visited. Results confirmed our interview assessments that VC was perceived to be better than correspondence; however only 16% of students agreed that the VC class 'is as good as a traditional environment'. Finally, only 26% looked forward to taking additional VC classes, 35% did not look forward to another experience, and 38% were neutral on this item.

The level of district support for teachers and students varied amongst school districts. Most teachers were provided with some technical training on operation of the equipment, but few had received in-depth pedagogical training on effective use of the technology. We also noted variations in the level of support provided to delivering teachers at the remote sites. In some cases, teacher aides at the remote sites undertook a variety of tasks including student supervision, distribution and return of class materials, and troubleshooting of technology. In other schools,



Figure 3. VC technology used for distributed staff meeting

supervision was assigned to a vice principal, librarian, or other adult at the remote school. The later option, while cost effective, placed increased duties and challenges on the delivery teacher, who often could not rely on continuous remote support. In most districts, a central administrator was assigned overall responsibility for the VC programming. In Alberta schools decision making, budgeting, and planning has largely devolved to the school level, therefore, programming that runs between multiple sites can create administrative challenges related to classroom and bus scheduling, bell ringing, announcements, holidays, teacher support, funding, and other local issues. Thus, the active central office participation in the design and operation of the VC programming is critical. Usually teachers were not given extra incentive to teach remotely and there was some sense that the teacher volunteers were given little choice but to participate in order to retain positions.

Professional Development and Administration

The VC systems were also used for a wide variety of administration (i.e., principals' meetings) professional development activities (professional association and board levels), curriculum development meetings, and

curricular and extra curricular planning meetings. These administrative applications of videoconferencing were generally valued and appreciated by participants. As expected, rural schools were more interested in this affordance than their urban counterparts due to the challenges and costs of travel in rural Alberta (Anderson & Christiansen, in press). In a follow-up survey of all professional and technical staff involved in the VC research community of practice, 'professional development' emerged as one of the highest priorities and potential applications of the technologies. Using the technology to expose and provide opportunities for trial and practice, and thus demonstrate compatibility and relative ease of use of VC (Rogers, 2003) is an important sub-goal of VC enhanced professional development activities.

Unfortunately, there is still little formal education programming (i.e., Masters degree programs) currently available that uses the VC technology. This lack of programming is due, in part, to the newness of the network, the current challenge of developing seamless connectivity among school based intranets, and the challenges for professional development and advanced degree awarding institutions to equip, train, and support their own VC-based delivery systems required to take advantage of the distributed VC capacity at local schools. Continued use and exposure will likely result in broader use of VC for both administration and PD activities.

Enrichment

The third major application of VC technology was for enhancement of classroom teaching by providing an external portal to some type of enrichment opportunity. Typically enrichment use consisted of a classroom linking via VC to a special guest (politician, scientist, etc.), linking to the special programming of a research institute, museum, etc., or to support dialogue across cultural and geographic distance as, for example, linking with students from another region of the country or of the world.

Unlike much of the distance education programming observed, the instructional designs employed by teachers supporting this enrichment model of VC use were of a constructive nature, in which students themselves played large roles in designing, producing, participating, recording, editing, and technically producing the VC sessions. Such levels of ownership by the students seemed to result in higher levels of interest and engagement than we observed in distance education applications. We also intervened, as a component of the research community of practice model, by working with self-selected teachers to develop programming of an inquiry based pedagogical model (Jacobsen, Clifford, & Friesen, 2002). This inquiry based model has been championed by the Galileo

Educational Network (<http://www.galileo.org>) who sought an opportunity to test the inquiry model in a distributed VC context. Galileo's director, Sharon Friesen, concluded that, "If VC is to do more than replace conventional 'stand and deliver' teaching in mathematics classes, then serious attention must be paid to the technical requirements needed to support meaningful collaboration across sites. It cannot be assumed that the simple translation of current best practices in VC will also work well with inquiry-based tasks and problems for students" (Alberta Education, 2006: 45).

Conclusion

None of the participants in this study seriously questioned the value of VC as an educational tool, although one respondent cautioned that the value of videoconferencing depended upon a special set of skills and training for teachers, as noted in the following:

I think it takes a special person (teacher) to want to be in this type of teaching environment and not be forced to do it.

There is still very little information out there in terms of "best practices". We must continue to communicate with one another and share success stories as well as frustrations so that we can learn from one another.

The study reinforces the long-term argument by Richard Clark and many others that it is the application, design, and ways that the technology is used that determines its educational value - not the simple acquisition or use of the technology (Clark, 1994, 2000).

To return to our research questions, I conclude that IP VC is being effectively used for a variety of 'somewhat diverse' applications by the early adopter schools. In rural school divisions, use of the technology as the primary tool for distance delivery of courses to small schools is the primary application. Administrative and professional development applications are also in evidence resulting in perception of increased and cost effective access to administrators, colleagues, and experts. We expect this application to increase as service providers (such as universities, health services, and other professional organizations) increase their use and connectivity using the SuperNet in the near future.

We found that there were large variations in the type of equipment (brand, standards used, number and size of monitors, recording capacity, peripheral equipment and microphones) in use. These five divisions, as early adopters, probably had an above average appreciation of the need for technical support and, generally, were doing a good job of providing on- and off-site technical support for the equipment. Professional development and pedagogical support, however, was much less apparent

and some of the school districts had no ongoing, planned, and sophisticated procedures in place to provide continuous professional development for either teacher, technical, or administrative development with the technology. All divisions, however, did recognize the importance of central coordination of the VC initiatives, and most had at least part-time centrally funded administrative support for planning, scheduling, and support.

New technologies usually require new pedagogies to fully realize the benefits of the affordances they provide (Stephenson, 2001). We observed the efforts of many adventuresome and courageous teachers providing increased access to education using these tools. However, as Marshall McLuhan pointed out in 1964 the first use of new technologies is usually in a "horseless carriage" style that mimics old ways of acting and thinking while using the new technology (McLuhan, 1964). Considerable support and training is needed for participants to move beyond thinking of videoconferencing as a technology that merely extends the classroom. The IP based videoconference tools, used in conjunction with other net tools, can be used to open the door to many different forms of distributed teaching and learning. The challenge for school leaders, teachers, and students is to engage in the, at times, painful process of learning to work effectively, efficiently, and even critically in new network-enhanced contexts that exploit new applications (Richardson, 2006) and pedagogies (Siemens, 2005) in the quest for improved ways of learning.

Finally, I assess if VC is the "killer app" that justifies public educational expenditures. I will pose two questions here: Does VC provide radically new affordances that work to significantly improved K-12 schools? Is it the pedagogical panacea that many hoped it would be? VC is undoubtedly a seductive technology for distance delivery, which, at first glance, appears to be highly compatible with tried and true means of teaching and learning that has evolved in classroom settings over generations. My conclusion based on the outcomes of this study, however, is that used by itself, VC provides a relatively impoverished form of distance education compared to distance programming that uses a blend of communication technologies. While VC can be more effectively used for classroom enhancement activities (even in distance education contexts) a much more student-centered environment could be developed using the affordances of a diverse set of networking tools (Gibbs & Gosper, 2006). Distance education programming that provides students access to Internet-based resources—such as interactive learning objects, accessed through full-featured Learning Management Systems, blogs, wikis and other personal learning environments that support student creation of content, and audio-graphic systems that provide students real-time use of polling, quizzes, web safaris, and applications

sharing—affords many more opportunities for student to interact with each other and content. Such systems provide much more opportunity for students to interact than simply listening to “teacher talk” that we found typical of distance education VC. Constructivist, collaborative and inquiry-based learning models demand that students be active and engaged and that this engagement leads to significant improvements in learning and attitudes towards learning (Jonassen, 2000; Bransford, Brown, & Cocking, 1999; Johnson & Johnson, 1994). As a stand-alone system, VC does not provide the level of student engagement with teachers, other students or content needed to sustain their attention, enthusiasm and ultimately high levels of learning. The place for videoconferencing in distance education is as one of many networked tools, used to best effect when high quality, synchronous interaction is demanded to meet particular social or curricular learning objectives. As a stand alone delivery tool, VC is no panacea and competes unfairly with perceptions and expectations of classroom delivery. However, as one modality in a multifaceted and networked learning context, it offers high levels of immediacy and social presence and therefore can play an important role in the networked distance education tool set.

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